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# Monthly Performance Report

LIVING SYSTEMS

NOVEMBER 1978

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## U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

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# MONTHLY PERFORMANCE REPORT

# LIVING SYSTEMS

# NOVEMBER 1978

## I. SYSTEM DESCRIPTION

The Living Systems site is a single-family residence in Davis, California. The home has approximately 1700 square feet of conditioned space. The solar energy system consists of two independently controlled systems: An active system for preheating domestic-hot-water (DHW) and a passive system for space heating the home.

The active solar DHW system has an array of flat-plate collectors with a gross area of 46 square feet. The array faces south at an angle of 45 degrees to the horizontal. Potable city water is the transfer medium used throughout the system. When water in the collector is sufficiently warmer than that in the preheat tank, the controller starts the circulation between the preheat storage tank and the collector. The preheat tank holds 82-gallons and water is supplied, on demand, to a conventional 20-gallon DHW tank. When the water preheated by solar energy is not hot enough to satisfy the hot water load, a natural gas burner in the 20-gallon DHW tank provides auxiliary energy for water heating. The system is shown schematically in Figure 1.

The passive solar space heating system is of the direct-gain type illustrated schematically in Figure 2. Incident solar energy is admitted to the building through both the large south-facing vertical windows (approximately 200 square feet) and the overhead skylight (approximately 80 square feet at 60 degrees from the horizontal). Manually operated insulating curtains provide insulation during the night and sunless days for the south-facing collector windows; manually operated insulating shutters provide night insulation for the skylight glazing and are aluminum coated to provide reflection to the space below when open. Solar energy storage is provided by blue-painted steel water-filled tubes containing approximately 3600 gallons of water placed near the south window wall and under the skylight. Additional storage is provided by the 6-inch-thick concrete slab floor of the building which is covered by brown tiles. Collected solar energy is distributed by natural convection, by conduction through the slab, and by radiation. Floor covering is minimal: linoleum in the kitchen and eating area and white shag rugs in two bedrooms. The building envelope is well insulated in order to ensure energy conservation, with R-19 insulation in the walls and R-30 insulation in the roof. The effective R-value of the window areas with curtains and shutters in place is in the range of R-2 to R-10. All glass surfaces are double-glazed with minimum window area in nonsouth-facing walls. Auxiliary space heating is provided by a gas-fired wall furnace; as with the solar heating, natural convection distributes the heat. Additional auxiliary energy can be supplied from a wood-burning stove.

Building summer overheat protection is provided by several means: First, roof overhangs over the south-facing glazed areas provide shading; second,

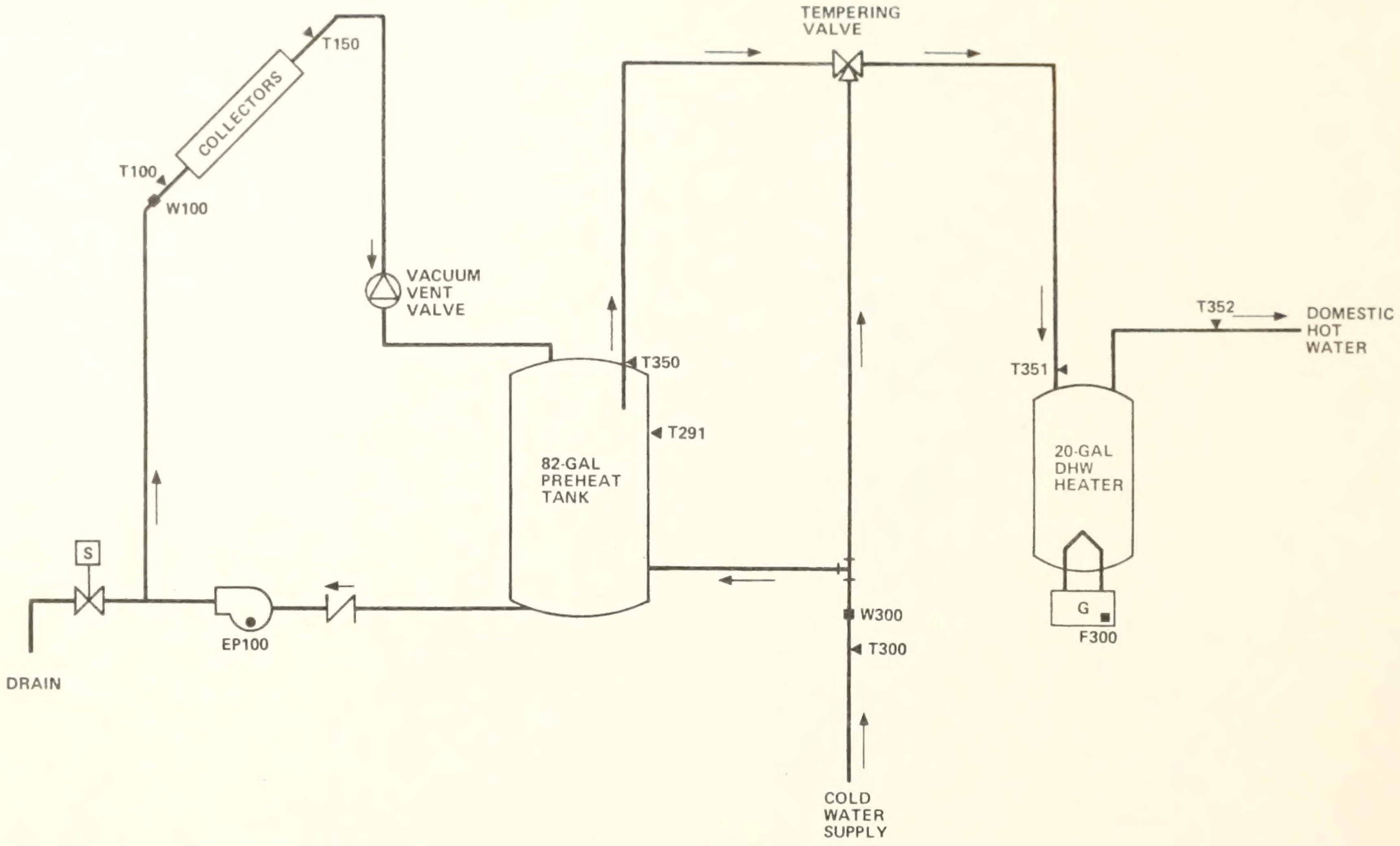
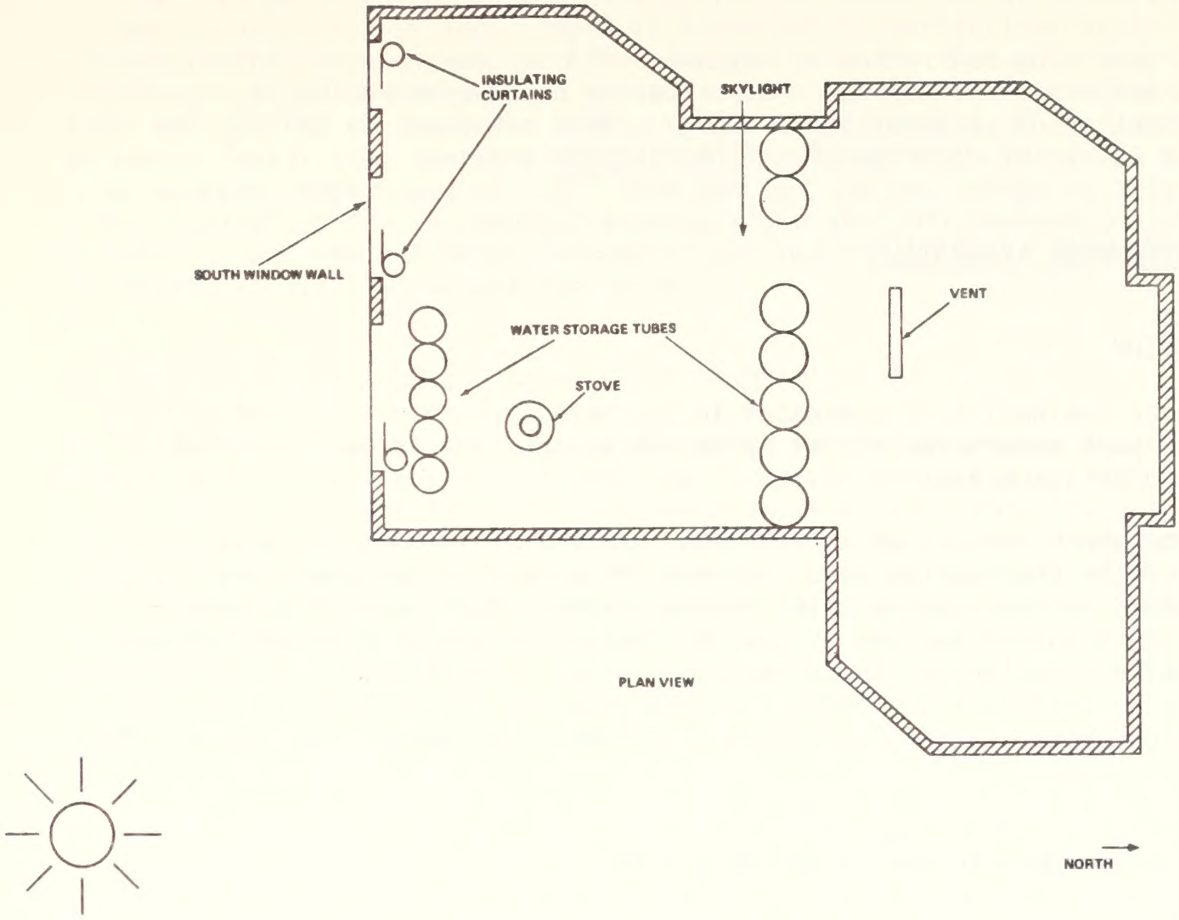
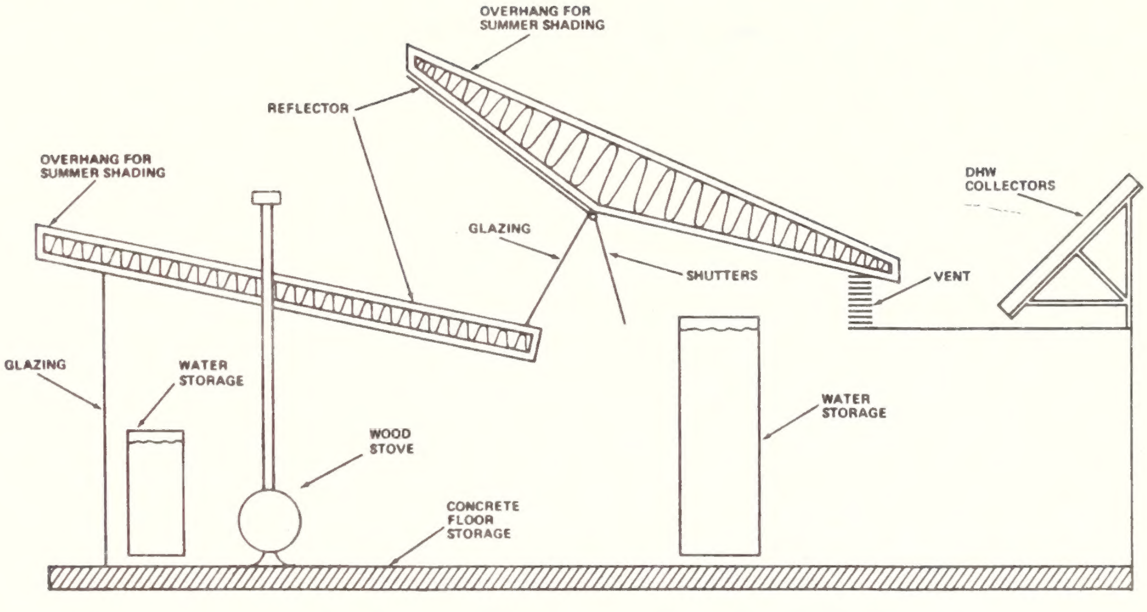


Figure 1. LIVING SYSTEMS ACTIVE SOLAR DOMESTIC HOT WATER SYSTEM SCHEMATIC



PLAN VIEW



EAST SIDE VIEW

*Figure 2. LIVING SYSTEMS PASSIVE SPACE HEATING SYSTEM*

operable windows in the south wall along with a vent in the north wall are used for cross-ventilation of the house at night, cooling the solar storage mass and providing moderation of daytime building temperatures; third, the curtains and shutters over the windows can be closed during the day to prevent collection of incident solar energy. When necessary, a ceiling fan is available to assist distribution of heating and venting.

## II. PERFORMANCE EVALUATION

### INTRODUCTION

Performance evaluation is presented in two parts for this solar energy site: The first part covers the active solar DHW system; the second covers the passive solar space heating system.

During the month the active solar energy system provided an estimate of 25 percent of the DHW heating load, whereas 77 percent of the space heating load was provided by the passive solar energy system. Operation of the wood-burning stove during periods of low incident solar energy provided backup energy while reducing the space heating demand. Variations in building temperature were minimal each day indicating the presence of substantial amounts of energy storage capacity. Comfort levels remained reasonable throughout the month.

### WEATHER CONDITIONS, ACTIVE SOLAR DHW SYSTEM

During the month, total incident solar energy on the DHW collector array was 1.6 million Btu for a daily average of 1133 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during November of 1322 Btu per square foot for a south-facing plane with a tilt of 45 degrees to the horizontal. The average ambient temperature during November was 51°F as compared with the long-term average for November of 53°F.

### THERMAL PERFORMANCE, ACTIVE SOLAR DHW SYSTEM

Collector - The total incident solar radiation on the DHW collector array for the month of November was 1.6 million Btu. During the period the collector loop was operating, the total insolation amounted to 1.4 million Btu. The total collected solar energy for the month of November was 0.50 million Btu, resulting in a collector array efficiency of 32 percent, based on total incident insolation. Solar energy delivered from the collector array to storage was 0.50 million Btu. Operating energy required by the collector loop was 0.074 million Btu.

DHW Load - The DHW system consumed an estimated 0.45 million Btu of solar energy and a measured 1.3 million Btu of auxiliary fossil fuel energy to satisfy the hot water load. During this period the cold water flowmeter was inoperative and the solar energy delivered was not measured; however, based upon storage efficiency recorded during other periods, the solar fraction of this load was estimated to be 25 percent. The DHW system consumed a total of 0.074 million Btu of operating energy. The solar energy used resulted in an estimated fossil fuel energy savings of 0.75 million Btu. Water was delivered at an average temperature of 108°F from the DHW system. However, this is not a true indication for the monthly average since the building was occupied on November 1, but the hot water thermostat was not raised until November 6. Subsequently, 115°F water was delivered.

## WEATHER CONDITIONS, PASSIVE SOLAR SPACE HEATING SYSTEM

During the month, total incident solar energy on the passive collector south windows and skylight was 9.3 million Btu for a daily average of 1132 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during November of 1364 Btu per square foot for a south-facing plane with a tilt of 60 degrees to the horizontal. The average ambient temperature during November was 51°F as compared with the long-term average for November of 53°F.

## THERMAL PERFORMANCE, PASSIVE SOLAR SPACE HEATING SYSTEM

The total incident solar radiation on the collector windows for the month of November was 9.3 million Btu. The total solar energy for the month of November delivered to the space heating load was 4.6 million Btu, resulting in a collector array efficiency of 49 percent, based on total incident insolation. Auxiliary thermal energy of 1.4 million Btu (equivalent to 2.9 million Btu auxiliary fossil fuel energy) was added to satisfy a space heating load of 6.0 million Btu. This resulted in a fossil fuel energy savings of 7.6 million Btu. The solar fraction of this load was 77 percent. The average storage temperature for the month was 73°F.

On many days during November, the wood-burning stove was used to satisfy a measurable amount of the building load. The thermal energy derived from operation of the wood-burning stove is applied as a reduction to the building load; that is, the major difference between the building load and the space heating system demand is the energy derived from operating the wood stove. During November, this renewable energy was approximately 1.0 million Btu. Assuming a wood stove energy conversion efficiency of 75 percent, this 1.0 million Btu is approximately equivalent to 4 percent of a cord of dry hardwood (such as oak). In terms of the savings of nonrenewable energy, this renewable thermal energy derived from the wood is equivalent to over 1.7 million Btu of fossil fuel energy.

The interior comfort level was given as 72°F in zone 1, the south end of the building, and 70°F in zone 2, the north end. The temperature difference occurs because comfort zone 2 is heated by conduction through the slab and walls, and by convection and infiltration associated with the doors. The cooler temperatures in the bedrooms do not seem objectionable.

## OBSERVATIONS

During the first part of November, the new homeowner was moving in. It was November 6 before he raised the DHW thermostat to 115°F. For those six days, the active solar DHW system provided 96 percent of the DHW needs. The 0.074 million Btu of DHW operating energy is reasonable for the 0.75 million Btu of fossil fuel energy savings. The additional energy necessary for water delivery is provided by the city water pressure, but this is inherent in most DHW solar energy systems. The passive solar space heating system satisfied more than 95 percent of the heating load. Of the 21 days, there were 12 bright, sunny days when the vent was often used to maintain the comfort level. It was also used for fume exhaust associated with "burning in" a new cast-iron woodburner. Furthermore, the vent was left open from November 17 through November 21, a fairly chilly period when much of the auxiliary fossil fuel was used for heating, thus increasing the November system load. The insulating curtains and skylight shutters were not fully operational nor was the owner familiar with their affect on solar savings. The single ceiling fan was not used for heat distribution, thus the operating energy was nil. The maximum swing in storage temperature was 8°F on a day when storage was recharged after several days of low insolation. Better performance can be expected in the future.

Computed comfort levels inside the building were reasonable during the entire month in both zones of the building. The comfort level in zone 2 was slightly lower than that of zone 1, due to the method of transferring heat to zone 2 with zone 1 being the primary collection and storage area of the house.

The flowmeter measuring DHW usage is inoperative; consequently, the values for solar heat delivered by the DHW system were unmeasurable and not presented. The wind direction sensor failed on September 15; therefore, the values for wind direction are not presented.

## ENERGY SAVINGS

The solar energy systems yielded a total fossil fuel energy savings of 8.4 million Btu. The DHW system provided an estimated fossil fuel energy savings of 0.75 million Btu. The space heating system contributed a fossil fuel energy savings of 7.6 million Btu.

## III. ACTION STATUS

Correction of the sensor problems is scheduled for the next site visit by Boeing. On November 21, the data collection system stopped operation. This failure will require a priority repair visit by IBM.

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                  SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

                                 MONTHLY REPORT
                                  SITE SUMMARY

SITE: LIVING SYSTEMS  (159-2)  DAVIS, CALIFORNIA                  SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978


SITE/SYSTEM DESCRIPTION:
   THE LIVING SYSTEMS SOLAR DOMESTIC HOT WATER SYSTEM PROVIDES PREHEAT
   TO THE BUILDING DOMESTIC HOT WATER SYSTEM .  THIS ACTIVE
   SYSTEM USES FLAT PLATE COLLECTORS (46 SQ.FT.) TO HEAT WATER DIRECTLY
   IN A 82 GALLON STORAGE TANK.  AUXILIARY HOT WATER ENERGY IS PROVIDED
   BY NATURAL GAS IN THE 20 GALLON HOT WATER HEATER.

GENERAL SITE DATA:
   INCIDENT SOLAR ENERGY                                          1.563 MILLION BTU
                                                                  33976 BTU/SQ.FT.
   CCLLECTED SOLAR ENERGY                                         0.497 MILLION BTU
                                                                  10814 BTU/SQ.FT.
   AVERAGE AMBIENT TEMPERATURE                                       51 DEGREES F
   AVERAGE BUILDING TEMPERATURE                                      68 DEGREES F
   ECSS SOLAR CONVERSICN EFFICIENCY                                   *
   ECSS OPERATING ENERGY                                          0.074 MILLION BTU
   TCTAL SYSTEM OPERATING ENERGY                                  0.074 MILLION BTU
   TOTAL ENERGY CONSUMED                                          1.920 MILLION BTU

SUBSYSTEM SUMMARY:
                         HOT WATER        HEATING       COOLING        SYSTEM TOTAL
   LOAD                          *           N.A.          N.A.            * MILLION BTU
   SOLAR FRACTION                *           N.A.          N.A.            * PERCENT
   SCLAR ENERGY USED             *           N.A.          N.A.            * MILLION BTU
   OPERATING ENERGY           N.A.           N.A.          N.A.        0.074 MILLION BTU
   AUX. THERMAL ENERGY       0.807           N.A.          N.A.        0.807 MILLION BTU
   AUX. ELECTRIC FUEL         N.A.           N.A.          N.A.         N.A. MILLION BTU
   AUX. FOSSIL FUEL          1.345           N.A.          N.A.        1.345 MILLION BTU
   ELECTRICAL SAVINGS         N.A.           N.A.          N.A.       -0.074 MILLION BTU
   FCSSIL SAVINGS                *           N.A.          N.A.            * MILLION BTU

SYSTEM PERFORMANCE FACTOR:                      *

*  DENOTES UNAVAILABLE DATA
@  DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
           OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978,
           SOLAR/0004-78/18
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                 SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

                                  MONTHLY REPORT
                                   SITE SUMMARY

SITE: LIVING SYSTEMS  (159-2)  DAVIS, CALIFORNIA                       SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978


SITE/SYSTEM DESCRIPTION:
   THE LIVING SYSTEMS SOLAR DOMESTIC HOT WATER SYSTEM PROVIDES PREHEAT
   TO THE BUILDING DOMESTIC HOT WATER SYSTEM .  THIS ACTIVE
   SYSTEM USES FLAT PLATE COLLECTORS (46 SQ.FT.) TO HEAT WATER DIRECTLY
   IN A 82 GALLON STORAGE TANK.  AUXILIARY HOT WATER ENERGY IS PROVIDED
   BY NATURAL GAS IN THE 20 GALLON HOT WATER HEATER.

GENERAL SITE DATA:
   INCIDENT SOLAR ENERGY                                                 1.649 GIGA JOULES
                                                                        385828 KJ/SQ.M.
   COLLECTED SOLAR ENERGY                                                0.525 GIGA JOULES
                                                                        122806 KJ/SQ.M.
   AVERAGE AMBIENT TEMPERATURE                                              11 DEGREES C
   AVERAGE BUILDING TEMPERATURE                                             20 DEGREES C
   ECSS SOLAR CONVERSION EFFICIENCY                                      N.A.
   ECSS OPERATING ENERGY                                                 0.078 GIGA JOULES
   TOTAL SYSTEM OPERATING ENERGY                                         0.078 GIGA JOULES
   TOTAL ENERGY CONSUMED                                                 2.025 GIGA JOULES

SUBSYSTEM SUMMARY:
                              HOT WATER         HEATING          COOLING         SYSTEM TOTAL
   LOAD                               *            N.A.             N.A.              * GIGA JOULES
   SOLAR FRACTION                     *            N.A.             N.A.              * PERCENT
   SOLAR ENERGY USED                  *            N.A.             N.A.              * GIGA JOULES
   OPERATING ENERGY                N.A.            N.A.             N.A.          0.078 GIGA JOULES
   AUX. THERMAL ENG               0.851            N.A.             N.A.          0.851 GIGA JOULES
   AUX. ELECTRIC FUEL              N.A.            N.A.             N.A.           N.A. GIGA JOULES
   AUX. FOSSIL FUEL               1.419            N.A.             N.A.          1.419 GIGA JOULES
   ELECTRICAL SAVINGS              N.A.            N.A.             N.A.         -0.078 GIGA JOULES
   FOSSIL SAVINGS                     *            N.A.             N.A.              * GIGA JOULES

SYSTEM PERFORMANCE FACTOR:                             *

*  DENOTES UNAVAILABLE DATA
@  DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
           OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978,
           SOLAR/0004-78/18
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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: LIVING SYSTEMS (159-2) DAVIS, CALIFORNIA SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MONTH | INCIDENT SOLAR ENERGY MILLION BTU | AMBIENT TEMP DEG-F | ENERGY TO LOADS MILLION BTU | AUX THERMAL TO ECSS MILLION BTU | ECSS OPERATING ENERGY MILLION BTU | ECSS ENERGY REJECTED MILLION BTU | ECSS SOLAR CONVERSION EFFICIENCY |
|---|---|---|---|---|---|---|---|
| 1 | 0.066 | 54 | * | N | 0.003 | N | * |
| 2 | 0.078 | 58 | * | O | 0.004 | O | * |
| 3 | 0.079 | 58 | * | T | 0.004 | T | * |
| 4 | 0.063 | 57 | * |  | 0.003 |  | * |
| 5 | 0.086 | 61 | * | A | 0.004 | A | * |
| 6 | 0.067 | 58 | * | P | 0.003 | P | * |
| 7 | 0.062 | 58 | * | P | 0.003 | P | * |
| 8 | 0.085 | 59 | * | L | 0.004 | L | * |
| 9 | 0.079 | 57 | * | I | 0.004 | I | * |
| 10 | 0.075 | 50 | * | C | 0.003 | C | * |
| 11 | 0.035 | 43 | * | A | 0.001 | A | * |
| 12 | 0.006 | 41 | * | B | 0.000 | B | * |
| 13 | 0.042 | 42 | * | L | 0.002 | L | * |
| 14 | 0.089 | 45 | * | E | 0.004 | E | * |
| 15 | 0.021 | 40 | * |  | 0.001 |  | * |
| 16 | 0.015 | 48 | * |  | 0.001 |  | * |
| 17 | 0.084 | 50 | * |  | 0.004 |  | * |
| 18 | 0.036 | 48 | * |  | 0.002 |  | * |
| 19 | 0.004 | 49 | * |  | 0.000 |  | * |
| 20 | 0.003 | 51 | * |  | 0.000 |  | * |
| 21 | 0.022 | 50 | * |  | 0.001 |  | * |
| 22 | * | * | * |  | * |  | * |
| 23 | * | * | * |  | * |  | * |
| 24 | * | * | * |  | * |  | * |
| 25 | * | * | * |  | * |  | * |
| 26 | * | * | * |  | * |  | * |
| 27 | * | * | * |  | * |  | * |
| 28 | * | * | * |  | * |  | * |
| 29 | * | * | * |  | * |  | * |
| 30 | * | * | * |  | * |  | * |
| SUM | 1.563 | - | * | N.A. | 0.074 | N.A. | - |
| AVG | 0.052 | 51 | * | N.A. | 0.002 | N.A. | * |
| NBS ID | Q001 | N113 |  |  | Q102 |  | N111 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: LIVING SYSTEMS (159-2) DAVIS, CALIFORNIA SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MONTH | INCIDENT SOLAR ENERGY MILLION BTU | OPERATIONAL INCIDENT ENERGY MILLION BTU | COLLECTED SOLAR ENERGY MILLION BTU | DAYTIME AMBIENT TEMP DEG F | COLLECTOR ARRAY EFFICIENCY |
|---|---|---|---|---|---|
| 1 | 0.066 | 0.062 | 0.025 | 66 | 0.382 |
| 2 | 0.078 | 0.071 | 0.021 | 70 | 0.268 |
| 3 | 0.079 | 0.072 | 0.024 | 70 | 0.299 |
| 4 | 0.063 | 0.054 | 0.022 | 68 | 0.354 |
| 5 | 0.086 | 0.077 | 0.032 | 72 | 0.378 |
| 6 | 0.067 | 0.063 | 0.025 | 73 | 0.366 |
| 7 | 0.062 | 0.058 | 0.022 | 73 | 0.353 |
| 8 | 0.085 | 0.080 | 0.028 | 76 | 0.333 |
| 9 | 0.079 | 0.074 | 0.023 | 69 | 0.298 |
| 10 | 0.075 | 0.065 | 0.022 | 56 | 0.302 |
| 11 | 0.035 | 0.024 | 0.010 | 50 | 0.301 |
| 12 | 0.006 | 0.000 | 0.000 | 46 | 0.000 |
| 13 | 0.042 | 0.038 | 0.012 | 48 | 0.285 |
| 14 | 0.089 | 0.085 | 0.026 | 56 | 0.294 |
| 15 | 0.021 | 0.016 | 0.006 | 42 | 0.301 |
| 16 | 0.015 | 0.008 | 0.004 | 54 | 0.273 |
| 17 | 0.084 | 0.079 | 0.027 | 61 | 0.318 |
| 18 | 0.036 | 0.032 | 0.012 | 52 | 0.325 |
| 19 | 0.004 | 0.000 | 0.000 | 50 | 0.000 |
| 20 | 0.003 | 0.000 | 0.000 | 52 | 0.000 |
| 21 | 0.022 | 0.019 | 0.006 | 53 | 0.266 |
| 22 | * | * | * | * | * |
| 23 | * | * | * | * | * |
| 24 | * | * | * | * | * |
| 25 | * | * | * | * | * |
| 26 | * | * | * | * | * |
| 27 | * | * | * | * | * |
| 28 | * | * | * | * | * |
| 29 | * | * | * | * | * |
| 30 | * | * | * | * | * |
| SUM | 1.563 | 1.396 | 0.497 | - | - |
| AVG | 0.052 | 0.047 | 0.017 | 60 | 0.318 |
| NBSID | Q001 |  | Q100 |  | N100 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: LIVING SYSTEMS (159-2) DAVIS, CALIFORNIA SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MONTH | ENERGY TO STORAGE MILLION BTU | ENERGY FROM STORAGE MILLION BTU | CHANGE IN STORED ENERGY MILLION BTU | STORAGE AVERAGE TEMP DEG F | STORAGE EFFICIENCY |
|---|---|---|---|---|---|
| 1 | 0.025 | * | N | N | N |
| 2 | 0.021 | * | O | O | O |
| 3 | 0.024 | * | T | T | T |
| 4 | 0.022 | * | | | |
| 5 | 0.032 | * | A | A | A |
| 6 | 0.025 | * | P | P | P |
| 7 | 0.022 | * | P | P | P |
| 8 | 0.028 | * | L | L | L |
| 9 | 0.023 | * | I | I | I |
| 10 | 0.022 | * | C | C | C |
| 11 | 0.010 | * | A | A | A |
| 12 | 0.000 | * | B | B | B |
| 13 | 0.012 | * | L | L | L |
| 14 | 0.026 | * | E | E | E |
| 15 | 0.006 | * | | | |
| 16 | 0.004 | * | | | |
| 17 | 0.027 | * | | | |
| 18 | 0.012 | * | | | |
| 19 | 0.000 | * | | | |
| 20 | 0.000 | * | | | |
| 21 | 0.006 | * | | | |
| 22 | * | * | | | |
| 23 | * | * | | | |
| 24 | * | * | | | |
| 25 | * | * | | | |
| 26 | * | * | | | |
| 27 | * | * | | | |
| 28 | * | * | | | |
| 29 | * | * | | | |
| 30 | * | * | | | |
| SUM | 0.497 | * | N.A. | - | - |
| AVG | 0.017 | * | N.A. | N.A. | N.A. |
| NBS ID | Q200 | Q201 | Q202 | | N108 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

# SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

## MONTHLY REPORT
## HOT WATER SUBSYSTEM

SITE: LIVING SYSTEMS (159-2) DAVIS, CALIFORNIA SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MON. | HOT WATER LOAD MILLION BTU | SOLAR FR.OF LOAD PER CENT | SOLAR ENERGY USED MILLION BTU | OPER ENERGY MILLION BTU | AUX THERMAL USED MILLION BTU | AUX ELECT FUEL MILLION BTU | AUX FOSSIL FUEL MILLION BTU | ELECT ENERGY SAVINGS MILLION BTU | FOSSIL ENERGY SAVINGS MILLION BTU | SUP. WAT. TEMP DEG F | HOT WAT. TEMP DEG F | HOT WATER USED GAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * | * | * | N | 0.000 | N | 0.000 | N | * | 71 | 72 | * |
| 2 | * | * | * | O | 0.000 | O | 0.000 | O | * | 74 | 77 | * |
| 3 | * | * | * | T | 0.003 | T | 0.005 | T | * | 74 | 84 | * |
| 4 | * | * | * |  | 0.002 |  | 0.003 |  | * | 75 | 105 | * |
| 5 | * | * | * | A | 0.004 | A | 0.006 | A | * | 74 | 101 | * |
| 6 | * | * | * | P | 0.011 | P | 0.019 | P | * | 75 | 109 | * |
| 7 | * | * | * | P | 0.019 | P | 0.031 | P | * | 76 | 113 | * |
| 8 | * | * | * | L | 0.015 | L | 0.024 | L | * | 76 | 113 | * |
| 9 | * | * | * | I | 0.025 | I | 0.041 | I | * | 74 | 110 | * |
| 10 | * | * | * | C | 0.039 | C | 0.065 | C | * | 72 | 113 | * |
| 11 | * | * | * | A | 0.027 | A | 0.045 | A | * | 70 | 114 | * |
| 12 | * | * | * | B | 0.062 | B | 0.103 | B | * | 70 | 116 | * |
| 13 | * | * | * | L | 0.055 | L | 0.091 | L | * | 70 | 119 | * |
| 14 | * | * | * | E | 0.025 | E | 0.042 | E | * | 72 | 113 | * |
| 15 | * | * | * |  | 0.024 |  | 0.040 |  | * | 70 | 118 | * |
| 16 | * | * | * |  | 0.042 |  | 0.070 |  | * | 71 | 113 | * |
| 17 | * | * | * |  | 0.026 |  | 0.044 |  | * | 71 | 114 | * |
| 18 | * | * | * |  | 0.036 |  | 0.061 |  | * | 71 | 115 | * |
| 19 | * | * | * |  | 0.037 |  | 0.062 |  | * | 70 | 118 | * |
| 20 | * | * | * |  | 0.066 |  | 0.110 |  | * | 70 | 118 | * |
| 21 | * | * | * |  | 0.048 |  | 0.079 |  | * | 71 | 118 | * |
| 22 | * | * | * |  | * |  | * |  | * | * | * | * |
| 23 | * | * | * |  | * |  | * |  | * | * | * | * |
| 24 | * | * | * |  | * |  | * |  | * | * | * | * |
| 25 | * | * | * |  | * |  | * |  | * | * | * | * |
| 26 | * | * | * |  | * |  | * |  | * | * | * | * |
| 27 | * | * | * |  | * |  | * |  | * | * | * | * |
| 28 | * | * | * |  | * |  | * |  | * | * | * | * |
| 29 | * | * | * |  | * |  | * |  | * | * | * | * |
| 30 | * | * | * |  | * |  | * |  | * | * | * | * |
| SUM | * | - | * | N.A. | 0.807 | N.A. | 1.345 | N.A. | * | - | - | * |
| AVG | * | * | * | N.A. | 0.027 | N.A. | 0.045 | N.A. | * | 72 | 108 | * |
| NBS | Q302 | N300 | Q300 | Q303 | Q301 | Q305 | Q306 | Q311 | Q313 | N305 | N307 | N308 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: LIVING SYSTEMS (159-2) DAVIS, CALIFORNIA SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MONTH | TOTAL INSOLATION BTU/SQ.FT | DIFFUSE INSOLATION BTU/SQ.FT | AMBIENT TEMPERATURE DEG F | DAYTIME AMBIENT TEMP DEG F | RELATIVE HUMIDITY PERCENT | WIND DIRECTION DEGREES | WIND SPEED M.P.H. |
|---|---|---|---|---|---|---|---|
| 1 | 1436 | N | 54 | 66 | 49 | * | 4 |
| 2 | 1687 | O | 58 | 70 | 43 | * | 4 |
| 3 | 1713 | T | 58 | 70 | 50 | * | 2 |
| 4 | 1377 | | 57 | 68 | 50 | * | 2 |
| 5 | 1864 | A | 61 | 72 | 41 | * | 6 |
| 6 | 1458 | P | 58 | 73 | 43 | * | 1 |
| 7 | 1349 | P | 58 | 73 | 40 | * | 3 |
| 8 | 1847 | L | 59 | 76 | 41 | * | 2 |
| 9 | 1709 | I | 57 | 69 | 32 | * | 14 |
| 10 | 1621 | C | 50 | 56 | 20 | * | 22 |
| 11 | 756 | A | 43 | 50 | 28 | * | 13 |
| 12 | 124 | B | 41 | 46 | 71 | * | 7 |
| 13 | 911 | L | 42 | 48 | 83 | * | 7 |
| 14 | 1940 | E | 45 | 56 | 65 | * | 7 |
| 15 | 457 | | 40 | 42 | 85 | * | 1 |
| 16 | 323 | | 48 | 54 | 69 | * | 2 |
| 17 | 1817 | | 50 | 61 | 67 | * | 3 |
| 18 | 778 | | 48 | 52 | 85 | * | 3 |
| 19 | 78 | | 49 | 50 | 97 | * | 9 |
| 20 | 63 | | 51 | 52 | 100 | * | 6 |
| 21 | 476 | | 50 | 53 | 96 | * | 4 |
| 22 | * | | * | * | * | * | * |
| 23 | * | | * | * | * | * | * |
| 24 | * | | * | * | * | * | * |
| 25 | * | | * | * | * | * | * |
| 26 | * | | * | * | * | * | * |
| 27 | * | | * | * | * | * | * |
| 28 | * | | * | * | * | * | * |
| 29 | * | | * | * | * | * | * |
| 30 | * | | * | * | * | * | * |
| SUM | 33976 | N.A. | - | - | - | - | - |
| AVG | 1133 | N.A. | 51 | 60 | 60 | * | 6 |
| NBS ID | 0001 | | N113 | | | N115 | N114 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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                     SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

                                     MONTHLY REPORT
                                      SITE SUMMARY

SITE: LIVING SYSTEMS (159-1)   DAVIS, CALIFORNIA                       SOLAR/1046-78/1
REPORT PERIOD: NOVEMBER,1978


SITE/SYSTEM DESCRIPTION:
   THE LIVING SYSTEMS PASSIVE SOLAR SPACE HEATING SYSTEM PROVIDES
   SPACE HEATING FOR A 1700 SQUARE FOOT SINGLE FAMILY DWELLING. THE
   LARGE SOUTH-FACING WINDOW WALL AND CLERESTORY SKYLIGHT PERMIT DIRECT
   WINTER SUN TO ENTER THE HOUSE.  SOLAR ENERGY THERMAL STORAGE IS PRO-
   VIDED BY BOTH WATER FILLED TUBES AND THE CONCRETE SLAB FLOOR. MOVABLE
   SHUTTERS AND INSULATING CURTAINS PROVIDE CAPABILITY TO REDUCE NIGHT
   HEAT LOSSES. SUMMER OVERHEAT PROTECTION IS PROVIDED BY ROOF OVERHANGS
   AND BY NATURAL VENTILATION.  AUXILIARY SPACE HEAT IS PROVIDED BY A
   NATURAL GAS FURNACE.

GENERAL SITE DATA:
   INCIDENT SOLAR ENERGY                                   9.271 MILLION BTU
                                                           33959 BTU/SQ.FT.
   COLLECTED SOLAR ENERGY                                   N.A. MILLION BTU
                                                           16659 BTU/SQ.FT.
   AVERAGE AMBIENT TEMPERATURE                                51 DEGREES F
   AVERAGE BUILDING TEMPERATURE                               68 DEGREES F
   ECSS SOLAR CONVERSION EFFICIENCY                         0.49
   ECSS OPERATING ENERGY                                    N.A. MILLION BTU
   TOTAL SYSTEM OPERATING ENERGY                            N.A. MILLION BTU
   TOTAL ENERGY CONSUMED                                   7.505 MILLION BTU

SUBSYSTEM SUMMARY:
                     HOT WATER        HEATING       COOLING        SYSTEM TOTAL
   LOAD                   N.A.          5.962          N.A.        5.962 MILLION BTU
   SOLAR FRACTION         N.A.             77          N.A.           77 PERCENT
   SOLAR ENERGY USED      N.A.          4.567          N.A.        4.567 MILLION BTU
   OPERATING ENERGY       N.A.           N.A.          N.A.         N.A. MILLION BTU
   AUX. THERMAL ENERGY    N.A.          1.391          N.A.        1.391 MILLION BTU
   AUX. ELECTRIC FUEL     N.A.           N.A.          N.A.         N.A. MILLION BTU
   AUX. FOSSIL FUEL       N.A.          2.930          N.A.        2.930 MILLION BTU
   ELECTRICAL SAVINGS     N.A.           N.A.          N.A.         N.A. MILLION BTU
   FOSSIL SAVINGS         N.A.          7.612          N.A.        7.612 MILLION BTU

SYSTEM PERFORMANCE FACTOR:              2.035

*  DENOTES UNAVAILABLE DATA
@  DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
           OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978,
           SOLAR/0004-78/18
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                    SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

                                    MONTHLY REPORT
                                     SITE SUMMARY

SITE: LIVING SYSTEMS (159-1)    DAVIS, CALIFORNIA                              SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978


SITE/SYSTEM DESCRIPTION:
   THE LIVING SYSTEMS PASSIVE SOLAR SPACE HEATING SYSTEM PROVIDES
   SPACE HEATING FOR A 1700 SQUARE FOOT SINGLE FAMILY DWELLING. THE
   LARGE SOUTH-FACING WINDOW WALL AND CLERESTORY SKYLIGHT PERMIT DIRECT
   WINTER SUN TO ENTER THE HOUSE.  SOLAR ENERGY THERMAL STORAGE IS PRO-
   VIDED BY BOTH WATER FILLED TUBES AND THE CONCRETE SLAB FLOOR. MOVABLE
   SHUTTERS AND INSULATING CURTAINS PROVIDE CAPABILITY TO REDUCE NIGHT
   HEAT LOSSES. SUMMER OVERHEAT PROTECTION IS PROVIDED BY ROOF OVERHANGS
   AND BY NATURAL VENTILATION.  AUXILIARY SPACE HEAT IS PROVIDED BY A
   NATURAL GAS FURNACE.

GENERAL SITE DATA:
   INCIDENT SOLAR ENERGY                                                   9.781 GIGA JOULES
                                                                          385644 KJ/SQ.M.
   COLLECTED SOLAR ENERGY                                                   N.A. GIGA JOULES
                                                                          189179 KJ/SQ.M.
   AVERAGE AMBIENT TEMPERATURE                                                11 DEGREES C
   AVERAGE BUILDING TEMPERATURE                                               20 DEGREES C
   ECSS SOLAR CONVERSION EFFICIENCY                                         0.49
   ECSS OPERATING ENERGY                                                    N.A. GIGA JOULES
   TOTAL SYSTEM OPERATING ENERGY                                            N.A. GIGA JOULES
   TOTAL ENERGY CONSUMED                                                   7.918 GIGA JOULES

SUBSYSTEM SUMMARY:
                          HOT WATER          HEATING          COOLING          SYSTEM TOTAL
   LOAD                        N.A.            6.290             N.A.          6.290 GIGA JOULES
   SOLAR FRACTION              N.A.               77             N.A.             77 PERCENT
   SOLAR ENERGY USED           N.A.            4.818             N.A.          4.818 GIGA JOULES
   OPERATING ENERGY            N.A.             N.A.             N.A.           N.A. GIGA JOULES
   AUX. THERMAL ENG            N.A.            1.467             N.A.          1.467 GIGA JOULES
   AUX. ELECTRIC FUEL          N.A.             N.A.             N.A.           N.A. GIGA JOULES
   AUX. FOSSIL FUEL            N.A.            3.091             N.A.          3.091 GIGA JOULES
   ELECTRICAL SAVINGS          N.A.             N.A.             N.A.           N.A. GIGA JOULES
   FOSSIL SAVINGS              N.A.            8.031             N.A.          8.031 GIGA JOULES

SYSTEM PERFORMANCE FACTOR:                     2.035

*   DENOTES UNAVAILABLE DATA
@   DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
           OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978,
           SOLAR/0004-78/18
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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: LIVING SYSTEMS (159-1)    DAVIS, CALIFORNIA    SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MONTH | INCIDENT SOLAR ENERGY MILLION BTU | OPERATIONAL INCIDENT ENERGY MILLION BTU | COLLECTED SOLAR ENERGY MILLION BTU | DAYTIME AMBIENT TEMP DEG F | COLLECTOR ARRAY EFFICIENCY |
|---|---|---|---|---|---|
| 1 | 0.387 | 0.387 | NOT APPLICABLE | 66 | NOT APPLICABLE |
| 2 | 0.460 | 0.460 | | 70 | |
| 3 | 0.466 | 0.466 | | 70 | |
| 4 | 0.371 | 0.371 | | 68 | |
| 5 | 0.513 | 0.513 | | 72 | |
| 6 | 0.399 | 0.399 | | 73 | |
| 7 | 0.366 | 0.366 | | 73 | |
| 8 | 0.511 | 0.511 | | 76 | |
| 9 | 0.467 | 0.467 | | 69 | |
| 10 | 0.452 | 0.452 | | 56 | |
| 11 | 0.201 | 0.201 | | 50 | |
| 12 | 0.031 | 0.031 | | 46 | |
| 13 | 0.241 | 0.241 | | 48 | |
| 14 | 0.541 | 0.541 | | 56 | |
| 15 | 0.125 | 0.125 | | 42 | |
| 16 | 0.078 | 0.078 | | 54 | |
| 17 | 0.509 | 0.509 | | 61 | |
| 18 | 0.212 | 0.212 | | 52 | |
| 19 | 0.017 | 0.017 | | 50 | |
| 20 | 0.013 | 0.013 | | 52 | |
| 21 | 0.129 | 0.129 | | 53 | |
| 22 | * | * | | * | |
| 23 | * | * | | * | |
| 24 | * | * | | * | |
| 25 | * | * | | * | |
| 26 | * | * | | * | |
| 27 | * | * | | * | |
| 28 | * | * | | * | |
| 29 | * | * | | * | |
| 30 | * | * | | * | |
| SUM | 9.271 | 9.271 | N.A. | - | - |
| AVG | 0.309 | 0.309 | N.A. | 60 | N.A. |
| NBSID | Q001 | | Q100 | | N100 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: LIVING SYSTEMS (159-1)    DAVIS, CALIFORNIA    SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MON. | SPACE HEATING LOAD MILLION BTU | SOLAR FR.OF LOAD PCT | SOLAR ENERGY USED MILLION BTU | OPER ENERGY MILLION BTU | AUX THERMAL USED MILLION BTU | AUX ELECT FUEL MILLION BTU | AUX FOSSIL FUEL MILLION BTU | ELECT ENERGY SAVINGS MILLION BTU | FOSSIL ENERGY SAVINGS MILLION BTU | BLDG TEMP DEG. F | AMB TEMP DEG. F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.029 | 100 | 0.029 | N | 0.000 | N | 0.000 | N | 0.048 | 70 | 54 |
| 2 | 0.179 | 100 | 0.179 | O | 0.000 | O | 0.000 | O | 0.299 | 71 | 58 |
| 3 | 0.182 | 100 | 0.182 | T | 0.000 | T | 0.000 | T | 0.304 | 72 | 58 |
| 4 | 0.186 | 100 | 0.186 |  | 0.000 |  | 0.014 |  | 0.311 | 72 | 57 |
| 5 | 0.160 | 100 | 0.160 | A | 0.000 | A | 0.016 | A | 0.267 | 72 | 61 |
| 6 | 0.215 | 100 | 0.215 | P | 0.000 | P | 0.016 | P | 0.358 | 72 | 58 |
| 7 | 0.225 | 99 | 0.222 | P | 0.003 | P | 0.018 | P | 0.370 | 72 | 58 |
| 8 | 0.235 | 99 | 0.232 | L | 0.003 | L | 0.017 | L | 0.386 | 73 | 59 |
| 9 | 0.157 | 100 | 0.157 | I | 0.000 | I | 0.017 | I | 0.261 | 71 | 57 |
| 10 | 0.133 | 97 | 0.129 | C | 0.004 | C | 0.023 | C | 0.215 | 68 | 50 |
| 11 | 0.283 | 82 | 0.231 | A | 0.052 | A | 0.110 | A | 0.385 | 66 | 43 |
| 12 | 0.292 | 82 | 0.240 | B | 0.052 | B | 0.107 | R | 0.400 | 64 | 41 |
| 13 | 0.262 | 72 | 0.190 | L | 0.073 | L | 0.140 | L | 0.316 | 65 | 42 |
| 14 | 0.224 | 58 | 0.130 | E | 0.094 | E | 0.188 | E | 0.217 | 67 | 45 |
| 15 | 0.304 | 57 | 0.174 |  | 0.130 |  | 0.256 |  | 0.290 | 64 | 40 |
| 16 | 0.179 | 26 | 0.047 |  | 0.133 |  | 0.257 |  | 0.078 | 66 | 48 |
| 17 | 0.201 | 84 | 0.169 |  | 0.032 |  | 0.075 |  | 0.282 | 67 | 50 |
| 18 | 0.223 | 69 | 0.155 |  | 0.066 |  | 0.135 |  | 0.258 | 65 | 48 |
| 19 | 0.193 | 73 | 0.141 |  | 0.052 |  | 0.107 |  | 0.235 | 64 | 49 |
| 20 | 0.127 | 17 | 0.022 |  | 0.105 |  | 0.215 |  | 0.037 | 64 | 51 |
| 21 | 0.184 | 4 | 0.008 |  | 0.177 |  | 0.342 |  | 0.013 | 65 | 50 |
| 22 | * | * | * |  | * |  | * |  | * | * | * |
| 23 | * | * | * |  | * |  | * |  | * | * | * |
| 24 | * | * | * |  | * |  | * |  | * | * | * |
| 25 | * | * | * |  | * |  | * |  | * | * | * |
| 26 | * | * | * |  | * |  | * |  | * | * | * |
| 27 | * | * | * |  | * |  | * |  | * | * | * |
| 28 | * | * | * |  | * |  | * |  | * | * | * |
| 29 | * | * | * |  | * |  | * |  | * | * | * |
| 30 | * | * | * |  | * |  | * |  | * | * | * |
| SUM | 5.962 | - | 4.567 | N.A. | 1.391 | N.A. | 2.930 | N.A. | 7.612 | - | - |
| AVG | 0.199 | 77 | 0.152 | N.A. | 0.046 | N.A. | 0.098 | N.A. | 0.254 | 68 | 51 |
| NBS | Q402 | N400 | Q400 | Q403 | Q401 |  | Q410 | Q415 | Q417 | N406 | N113 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: LIVING SYSTEMS (159-1)    DAVIS, CALIFORNIA    SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MONTH | TOTAL INSOLATION BTU/SQ.FT | DIFFUSE INSOLATION BTU/SQ.FT | AMBIENT TEMPERATURE DEG F | DAYTIME AMBIENT TEMP DEG F | RELATIVE HUMIDITY PERCENT | WIND DIRECTION DEGREES | WIND SPEED M.P.H. |
|---|---|---|---|---|---|---|---|
| 1 | 1418 | N | 54 | 66 | 49 | * | 4 |
| 2 | 1684 | O | 58 | 70 | 43 | * | 4 |
| 3 | 1706 | T | 58 | 70 | 50 | * | 2 |
| 4 | 1360 |  | 57 | 68 | 50 | * | 2 |
| 5 | 1880 | A | 61 | 72 | 41 | * | 6 |
| 6 | 1462 | P | 58 | 73 | 43 | * | 1 |
| 7 | 1342 | P | 58 | 73 | 40 | * | 3 |
| 8 | 1872 | L | 59 | 76 | 41 | * | 2 |
| 9 | 1711 | I | 57 | 69 | 32 | * | 14 |
| 10 | 1654 | C | 50 | 56 | 20 | * | 22 |
| 11 | 737 | A | 43 | 59 | 28 | * | 13 |
| 12 | 115 | B | 41 | 46 | 71 | * | 7 |
| 13 | 882 | L | 42 | 48 | 83 | * | 7 |
| 14 | 1983 | E | 45 | 56 | 65 | * | 7 |
| 15 | 458 |  | 40 | 42 | 85 | * | 1 |
| 16 | 286 |  | 48 | 54 | 69 | * | 2 |
| 17 | 1866 |  | 50 | 61 | 67 | * | 3 |
| 18 | 776 |  | 48 | 52 | 85 | * | 3 |
| 19 | 61 |  | 49 | 50 | 97 | * | 9 |
| 20 | 49 |  | 51 | 52 | 100 | * | 6 |
| 21 | 472 |  | 50 | 53 | 96 | * | 4 |
| 22 | * |  | * | * | * | * | * |
| 23 | * |  | * | * | * | * | * |
| 24 | * |  | * | * | * | * | * |
| 25 | * |  | * | * | * | * | * |
| 26 | * |  | * | * | * | * | * |
| 27 | * |  | * | * | * | * | * |
| 28 | * |  | * | * | * | * | * |
| 29 | * |  | * | * | * | * | * |
| 30 | * |  | * | * | * | * | * |
| SUM | 33959 | N.A. | - | - | - | - | - |
| AVG | 1132 | N.A. | 51 | 60 | 60 | * | 6 |
| NBS ID | Q001 |  | N113 |  |  | N115 | N114 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
PASSIVE SPACE HEATING

SITE: LIVING SYSTEMS (159-1)    DAVIS, CALIFORNIA    SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MON | SPACE HEATING LOAD MILLION BTU | SOLAR ENERGY USED MILLION BTU | CHANGE IN STORE ENERGY MILLION BTU | AVERAGE STORAGE TEMP DEG F | DIRECT SOLAR UTIL EFFIC | AUX THERMAL USED MILLION BTU | BLDG TEMP DEG F | AMB TEMP DEG F | WIND AVG SPEED MPH | WIND AVG DIR DEG | SOLAR FR LOAD PER CENT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.028 | 0.028 | 0.270 | 72.4 | 0.075 | 0.000 | 70 | 54 | 3.6 | * | 100 |
| 2 | 0.179 | 0.179 | 0.075 | 74.9 | 0.390 | 0.000 | 71 | 58 | 3.6 | * | 100 |
| 3 | 0.182 | 0.182 | 0.085 | 75.3 | 0.391 | 0.000 | 72 | 58 | 2.3 | * | 100 |
| 4 | 0.186 | 0.186 | -0.002 | 75.4 | 0.502 | 0.000 | 72 | 57 | 1.9 | * | 100 |
| 5 | 0.160 | 0.160 | 0.060 | 76.2 | 0.312 | 0.000 | 72 | 61 | 6.2 | * | 100 |
| 6 | 0.214 | 0.214 | -0.007 | 76.1 | 0.537 | 0.000 | 72 | 58 | 1.1 | * | 100 |
| 7 | 0.225 | 0.222 | 0.012 | 75.9 | 0.606 | 0.003 | 72 | 58 | 2.9 | * | 99 |
| 8 | 0.234 | 0.231 | 0.087 | 76.8 | 0.453 | 0.003 | 73 | 59 | 1.5 | * | 99 |
| 9 | 0.156 | 0.156 | -0.075 | 77.2 | 0.335 | 0.000 | 71 | 57 | 13.5 | * | 100 |
| 10 | 0.132 | 0.128 | -0.132 | 76.9 | 0.286 | 0.003 | 68 | 50 | 21.5 | * | 97 |
| 11 | 0.283 | 0.231 | -0.196 | 74.1 | 1.150 | 0.051 | 66 | 43 | 12.7 | * | 82 |
| 12 | 0.291 | 0.240 | -0.178 | 70.2 | 7.663 | 0.051 | 64 | 41 | 7.2 | * | 82 |
| 13 | 0.262 | 0.189 | 0.001 | 69.2 | 0.788 | 0.072 | 65 | 42 | 7.2 | * | 72 |
| 14 | 0.223 | 0.129 | 0.151 | 71.2 | 0.240 | 0.094 | 67 | 45 | 6.9 | * | 58 |
| 15 | 0.303 | 0.174 | -0.122 | 70.0 | 1.393 | 0.129 | 64 | 40 | 1.3 | * | 57 |
| 16 | 0.179 | 0.046 | 0.005 | 69.1 | 0.599 | 0.132 | 66 | 48 | 2.3 | * | 26 |
| 17 | 0.201 | 0.169 | 0.114 | 70.8 | 0.332 | 0.032 | 67 | 50 | 3.0 | * | 84 |
| 18 | 0.223 | 0.154 | -0.082 | 70.5 | 0.732 | 0.065 | 65 | 48 | 3.4 | * | 69 |
| 19 | 0.192 | 0.140 | -0.152 | 68.5 | 8.494 | 0.051 | 64 | 49 | 9.2 | * | 73 |
| 20 | 0.126 | 0.021 | -0.008 | 67.3 | 1.651 | 0.104 | 64 | 51 | 6.0 | * | 17 |
| 21 | 0.184 | 0.007 | 0.080 | 67.9 | 0.059 | 0.176 | 65 | 50 | 4.4 | * | 4 |
| 22 | * | * | * | * | * | * | * | * | * | * | * |
| 23 | * | * | * | * | * | * | * | * | * | * | * |
| 24 | * | * | * | * | * | * | * | * | * | * | * |
| 25 | * | * | * | * | * | * | * | * | * | * | * |
| 26 | * | * | * | * | * | * | * | * | * | * | * |
| 27 | * | * | * | * | * | * | * | * | * | * | * |
| 28 | * | * | * | * | * | * | * | * | * | * | * |
| 29 | * | * | * | * | * | * | * | * | * | * | * |
| 30 | * | * | * | * | * | * | * | * | * | * | * |
| SUM | 5.961 | 4.567 | -0.019 | - | - | 1.390 | - | - | - | - | - |
| AVG | 0.198 | 0.152 | 0.000 | 72.7 | 0.493 | 0.046 | 68 | 51 | 5.8 | * | 77 |
| NBS | Q402 | Q400 | Q202 |  |  | Q401 | N405 | N113 | N114 | N115 | N400 |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
PASSIVE SYSTEM ENVIRONMENT

SITE: LIVING SYSTEMS (159-1)    DAVIS, CALIFORNIA    SOLAR/1046-78/11
REPORT PERIOD: NOVEMBER,1978

| DAY OF MON | BUILDING COMFORT ZONE 1 | BLDG COMF ZONE 2 | BUILDING TEMP MIDNIGHT DEG F | BUILDING TEMP 6 AM DEG F | BUILDING TEMP NOON DEG F | BUILDING TEMP 6 PM DEG F | INTERIOR RELATIVE HUMIDITY PERCENT | AMB TEMP DEG F | DAYTIME AMB TEMP DEG F | INCIDENT SOLAR ENERGY MILLION BTU | AVG STOR TEMP DEG F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 73 | 69 | 72 | 65 | 72 | 73 | 29 | 54 | 66 | 0.387 | 72 |
| 2 | 75 | 72 | 70 | 68 | 73 | 75 | 30 | 58 | 70 | 0.460 | 75 |
| 3 | 75 | 73 | 72 | 67 | 74 | 76 | 31 | 58 | 70 | 0.466 | 75 |
| 4 | 75 | 73 | 72 | 68 | 72 | 75 | 32 | 57 | 68 | 0.371 | 75 |
| 5 | 76 | 74 | 71 | 69 | 74 | 75 | 29 | 61 | 72 | 0.513 | 76 |
| 6 | 75 | 74 | 71 | 68 | 73 | 77 | 29 | 58 | 73 | 0.399 | 76 |
| 7 | 75 | 74 | 72 | 68 | 73 | 76 | 29 | 58 | 73 | 0.366 | 76 |
| 8 | 77 | 75 | 73 | 68 | 75 | 78 | 28 | 59 | 76 | 0.511 | 77 |
| 9 | 76 | 74 | 70 | 69 | 76 | 71 | 21 | 57 | 69 | 0.467 | 77 |
| 10 | 76 | 72 | 67 | 65 | 70 | 71 | 14 | 50 | 56 | 0.452 | 77 |
| 11 | 72 | 69 | 66 | 63 | 66 | 67 | 16 | 43 | 50 | 0.201 | 74 |
| 12 | 69 | 67 | 65 | 63 | 65 | 64 | 25 | 41 | 46 | 0.031 | 70 |
| 13 | 69 | 67 | 64 | 64 | 64 | 66 | 31 | 42 | 48 | 0.241 | 69 |
| 14 | 71 | 69 | 66 | 63 | 69 | 71 | 28 | 45 | 56 | 0.541 | 71 |
| 15 | 69 | 68 | 65 | 63 | 64 | 65 | 29 | 40 | 42 | 0.125 | 70 |
| 16 | 69 | 68 | 66 | 64 | 66 | 67 | 33 | 48 | 54 | 0.078 | 69 |
| 17 | 71 | 69 | 67 | 62 | 68 | 71 | 30 | 50 | 61 | 0.509 | 71 |
| 18 | 70 | 68 | 66 | 64 | 64 | 68 | 35 | 48 | 52 | 0.212 | 70 |
| 19 | 67 | 67 | 64 | 64 | 64 | 64 | 40 | 49 | 50 | 0.017 | 68 |
| 20 | 67 | 66 | 66 | 63 | 64 | 64 | 45 | 51 | 52 | 0.013 | 67 |
| 21 | 68 | 67 | 66 | 64 | 64 | 66 | 44 | 50 | 53 | 0.129 | 68 |
| 22 | * | * | * | * | * | * | * | * | * | * | * |
| 23 | * | * | * | * | * | * | * | * | * | * | * |
| 24 | * | * | * | * | * | * | * | * | * | * | * |
| 25 | * | * | * | * | * | * | * | * | * | * | * |
| 26 | * | * | * | * | * | * | * | * | * | * | * |
| 27 | * | * | * | * | * | * | * | * | * | * | * |
| 28 | * | * | * | * | * | * | * | * | * | * | * |
| 29 | * | * | * | * | * | * | * | * | * | * | * |
| 30 | * | * | * | * | * | * | * | * | * | * | * |
| SUM | - | - | - | - | - | - | - | - | - | 9.271 | - |
| AVG | 72 | 70 | 68 | 65 | 69 | 70 | 30 | 51 | 60 | 0.309 | 73 |
| NBS | | | | | | | | N113 | | | |

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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